

REMARKS

Claims 1,5, 7, and 10 have been amended. Claims 8, 9, and 11-22 have been cancelled. Claims 1-7 and 10 remain in the application. Further
5 examination and reconsideration of the application, as amended, is hereby requested.

Claims 13-22 were withdrawn as being drawn to a non-elected invention. Applicant has cancelled claims 13-22 and will pursue them in a divisional
10 application.

Claims 1-4 were rejected under 35 USC 102(b) as being anticipated by Fonstad, Jr et al. (Fonstad). Claims 5-12 were rejected under 35 USC 103(a) as being unpatentable over Fonstad. Further, Applicants are submitting a
15 supplemental IDS with newly discovered references which may be related to patentability. Applicants have amended claim 1 to more distinctly clarify and distinguish their invention over the cited art and the references cited in the supplemental IDS. Support for the amendments are found throughout the specification an in particular in paragraphs [0017], [0020], [0021], and [0023].

20 Fonstad discloses fusing two semiconductor wafers, a silicon substrate to a III-V material substrate (see Fonstad abstract). Contrarily, Applicants in claim 1, as amended, are claiming bonding a "substrate having an optical device" to a "glass" substrate. As noted in the Applicants' disclosure, prior art approaches to doing so have caused multiple reflections due to having different regions of
25 various refractive indices (see Applicants' background). However, the Applicants have by "depositing a layer of bonding substrate material of TEOS onto a bonding surface of a first substrate of glass" reduced the refractive index difference between the glass and a TEOS oxide surface enclosing the optical device on the substrate. At least one of the TEOS surfaces is subjected to plasma striking to
30 increase surface energy. The two substrates are compressed together at room temperature to form a fusion bond. This bonding is done without subjecting either of the substrates to a wet treatment. This technique provides a surface of TEOS on the glass substrate that will interact and bond with a "second substrate that includes TEOS enclosing an optical device" to allow for "fusion bonding at room

temperature." By performing the fusion bonding at room temperature, the optical device on the second substrate is not damaged by the high temperature of the traditional annealing process nor exposed to water or other liquid that may damage the optical device.

5 On the other hand, Fonstad discloses a hydrophilic bond at room temperature (or anodic or thermo anodic bonding, col. 5:58-6:26) and then subjecting the bonded substrates to a heat treatment of annealing to create a fusion bond (col. 7:5-8). Fonstad subjects the two substrates to a wet treatment (col. 5:57) or optionally a dry plasma to make the surfaces "hydrophilic".

10 Accordingly, Fonstad does not disclose or suggest Applicants claim 1, as amended.

Further, the Applicants' fusion bonding is done "using a compression force" to increase the strength of the fusion bonding similar to the level achieved by Tong (US Patent 6,902,987, which recently issued after the present Office Action was sent) without Tong's etching of the substrates or using a wet treatment of water or NH_4OH (see submitted declaration of Applicants' test results). As shown in Fig. 6A and col. 14:32-40 of Tong, if the etching by the plasma treatment isn't sufficiently strong (e.g. using a non RIE mode) the final bonding energy of direct plasma bonding is only 385 mJ/m^2 . However, Applicants avoid the etching of Tong, which may compromise optical imaging, and the wet treatment which may cause the optical devices to malfunction due to corrosion or stiction, by using plasma striking with a subsequent compression force to increase the bonding energy to greater than 500 mJ/m^2 (after 24 hours of room temperature annealing, see declaration) which is close to Tong's "Plasma mode with wet treatment" of NH_4OH (See Tong Fig. 6A). By annealing at higher temperatures such as 100°C , the bonding energy increases to 800 mJ/m^2 (see declaration) which is close to Tong's "RIE etch mode" with wet treatment of NH_4OH (see Tong Fig. 6A). Accordingly, by using a TEOS coating on the glass substrate and a TEOS enclosement of the optical device, a non-etching plasma treatment by using plasma striking without a wet treatment of water allows for a fusion bond of sufficient bonding energy when accompanied by a compression force during bonding. Subsequent annealing at either room or relatively low temperatures will further increase the bonding energy. These limitations in combination allow for the bonding of a glass substrate to a substrate having an optical device without

the loss of optical performance that would be achieved with Tong's process of plasma etching (which might roughen the surface) and wet treatment which would allow moisture to interfere with the optical devices operation or reduce the optical properties of the overall package (such as by fogging). Accordingly, claim 1 as
5 amended is not disclosed by Fonstad or Tong or other art made of record.
Withdrawal of the rejection under 35 USC 102(b) is respectfully requested.

Applicants believe their claims as amended are patentable over the art of record, and that the amendments made herein are within the scope of a search
10 properly conducted under the provisions of MPEP 904.02. Accordingly, claims 1-7 and 10 are deemed to be in condition for allowance, and such allowance is respectfully requested.

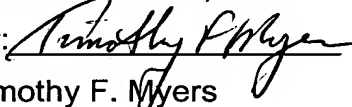
If for any reason the Examiner finds the Application other than in a condition for allowance, the Examiner is respectfully requested to call Applicants' undersigned representative at the number listed below to discuss the steps
15 necessary for placing the application in condition for allowance.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-2025. Should such fees be associated with an extension of time, Applicants
20 respectfully request that this paper be considered a petition therefore.

Hewlett-Packard Company
Legal Department
1000 NE Circle Blvd.
Corvallis, OR 97330
Telephone: (541)715-4197
Fax: (541)715-8581

Respectfully Submitted,

Chien-hua Chen, et al.

By: 

Timothy F. Myers

Patent Attorney

Registration No. 42,919